

CLAIMS

1. An apparatus, comprising:
 - a first encoder for receiving a plurality of symbol streams and encoding each of the symbol streams with one of a plurality of covering sequences to form a plurality of covered sequences;
 - a summer for summing the plurality of covered sequences to form a first Code Division Multiplexed (CDM) signal; and
 - a second encoder for covering the first CDM signal with a covering sequence to form a first covered CDM signal.
2. The apparatus of claim 1, further comprising one or more channel gain blocks for receiving a plurality of gain values and multiplying the plurality of covered sequences by the plurality of gain values, respectively, prior to delivery to the summer.
3. The apparatus of claim 1, wherein the first encoder comprises one or more Hadamard encoders.
4. The apparatus of claim 1, further comprising a transmitter for receiving the first covered CDM signal and one or more additional covered signals, combining the first covered CDM signal and the one or more additional covered signals to form a combined CDM signal, and transmitting the combined CDM signal to a remote station.
5. The apparatus of claim 1, further comprising:
 - a third encoder for receiving a second plurality of symbol streams and encoding each of the symbol streams with the plurality of covering sequences to form a second plurality of covered sequences;
 - a second summer for summing the second plurality of covered sequences to form a second Code Division Multiplexed (CDM) signal;
 - a fourth encoder for covering the second CDM signal with a covering sequence to form a second covered CDM signal; and

a transmitter for transmitting the first covered CDM signal on an in-phase channel and the second covered CDM signal on a quadrature channel.

6. The apparatus of claim 1, wherein one or more of the plurality of symbol streams comprises command values, the command values indicating acknowledgement, negative acknowledgement, or acknowledge and continue.

7. The apparatus of claim 1, wherein the encoder segments the encoding time into two or more segments and covers each of the plurality of symbol streams with two or more sequences, each sequence for covering during the two or more segments, respectively, and the sequence covering each symbol stream during a segment being unique to the respective symbol stream.

8. The apparatus of claim 7, wherein a first sequence is selected as a Hadamard sequence corresponding to a remote station identifier, and a second sequence is selected as a remote station identifier plus five modulo half the number of symbol streams in the plurality.

9. The apparatus of claim 7, wherein a first sequence is selected as a Hadamard sequence corresponding to a remote station identifier, and a second sequence is selected as a remote station identifier plus seven modulo half the number of symbol streams in the plurality.

10. The apparatus of claim 7, wherein each sequence is assigned in a time varying manner.

11. An apparatus, comprising:

a plurality of CDM encoders for receiving a plurality of symbol streams and producing a plurality of covered CDM signals, each CDM encoder comprising:

a first encoder for receiving the plurality of symbol streams and encoding each of the symbol streams with one of a plurality of covering sequences to form a plurality of covered sequences;

a summer for summing the plurality of covered sequences to form a CDM signal;

a time multiplexer for receiving the plurality of covered CDM signals and forming a Time Division Multiplexed (TDM) signal comprising the plurality of covered CDM signals; and

a second encoder for covering the TDM signal with a covering sequence to form a covered TDM/CDM signal.

12. The apparatus of claim 11, wherein each CDM encoder further comprises one or more channel gain blocks for receiving a plurality of gain values and multiplying the plurality of covered sequences by the plurality of gain values, respectively, prior to delivery to the summer.

13. The apparatus of claim 11, further comprising a transmitter for receiving the covered TDM/CDM signal and one or more additional covered signals, combining the covered TDM/CDM signal and one or more additional covered signals to form a combined CDM signal, and transmitting the combined CDM signal to a remote station.

14. An apparatus, operable with a CDM signal, covered with a first covering sequence, comprising one or more sub-CDM signals, each of the one or more sub-CDM signals comprising a plurality of symbol sequences covered by a second plurality of covering sequences, respectively, the apparatus comprising:

a receiver for receiving the CDM signal;

a first despreader for despreading the received CDM signal with the first covering sequence to produce a despread CDM signal; and

a second despreader for despreading the despread CDM signal with one of the second covering sequences to produce a recovered symbol sequence.

15. The apparatus of claim 14, wherein the second despreader further despreads the despread CDM signal with one or more additional second covering sequences to produce one or more additional recovered symbol sequences.

16. An apparatus, operable with a CDM signal, covered with a first covering sequence, comprising one or more TDM signals, each of the one or more TDM signals comprising one or more sub-CDM signals, each of the one or more sub-CDM signals comprising a plurality of symbol sequences covered by a second plurality of covering sequences, respectively, the apparatus comprising:

- a receiver for receiving the CDM signal;
- a first despreader for despreading the received CDM signal with the first covering sequence to produce a despread CDM signal;
- a demultiplexer for selecting one of the TDM signals from the despread CDM signal; and
- a second despreader for despreading the selected TDM signal with one of the second covering sequences to produce a recovered symbol sequence.

17. A wireless communication device, comprising:

- a first encoder for receiving a plurality of symbol streams and encoding each of the symbol streams with one of a plurality of covering sequences to form a plurality of covered sequences;
- a summer for summing the plurality of covered sequences to form a first Code Division Multiplexed (CDM) signal; and
- a second encoder for covering the first CDM signal with a covering sequence to form a first covered CDM signal.

18. A wireless communication device, comprising:

- a plurality of CDM encoders for receiving a plurality of symbol streams and producing a plurality of covered CDM signals, each CDM encoder comprising:
 - a first encoder for receiving the plurality of symbol streams and encoding each of the symbol streams with one of a plurality of covering sequences to form a plurality of covered sequences;
 - a summer for summing the plurality of covered sequences to form a CDM signal;
 - a time multiplexer for receiving the plurality of covered CDM signals and forming a Time Division Multiplexed (TDM) signal comprising the plurality of covered CDM signals; and

a second encoder for covering the TDM signal with a covering sequence to form a covered TDM/CDM signal.

19. A wireless communication device, operable with a CDM signal, covered with a first covering sequence, comprising one or more sub-CDM signals, each of the one or more sub-CDM signals comprising a plurality of symbol sequences covered by a second plurality of covering sequences, respectively, the apparatus comprising:

a receiver for receiving the CDM signal;

a first despreader for despreading the received CDM signal with the first covering sequence to produce a despread CDM signal; and

a second despreader for despreading the despread CDM signal with one of the second covering sequences to produce a recovered symbol sequence.

20. A wireless communication device, operable with a CDM signal, covered with a first covering sequence, comprising one or more TDM signals, each of the one or more TDM signals comprising one or more sub-CDM signals, each of the one or more sub-CDM signals comprising a plurality of symbol sequences covered by a second plurality of covering sequences, respectively, the apparatus comprising:

a receiver for receiving the CDM signal;

a first despreader for despreading the received CDM signal with the first covering sequence to produce a despread CDM signal;

a demultiplexer for selecting one of the TDM signals from the despread CDM signal; and

a second despreader for despreading the selected TDM signal with one of the second covering sequences to produce a recovered symbol sequence.

21. A wireless communication system, including a first wireless communication device comprising:

a first encoder for receiving a plurality of symbol streams and encoding each of the symbol streams with one of a plurality of covering sequences to form a plurality of covered sequences;

a summer for summing the plurality of covered sequences to form a first Code Division Multiplexed (CDM) signal; and

a second encoder for covering the first CDM signal with a covering sequence to form a first covered CDM signal.

22. The wireless communication system of claim 21, further comprising a second wireless communication device comprising:

a receiver for receiving the first covered CDM signal;

a first despreader for despreading the received CDM signal with the first covering sequence to produce a despread CDM signal; and

a second despreader for despreading the despread CDM signal with one of the second covering sequences to produce a recovered symbol sequence.

23. A wireless communication system, including a wireless communication device comprising:

a plurality of CDM encoders for receiving a plurality of symbol streams and producing a plurality of covered CDM signals, each CDM encoder comprising:

a first encoder for receiving the plurality of symbol streams and encoding each of the symbol streams with one of a plurality of covering sequences to form a plurality of covered sequences;

a summer for summing the plurality of covered sequences to form a CDM signal;

a time multiplexer for receiving the plurality of covered CDM signals and forming a Time Division Multiplexed (TDM) signal comprising the plurality of covered CDM signals; and

a second encoder for covering the TDM signal with a covering sequence to form a covered TDM/CDM signal.

24. The wireless communication system of claim 23, further comprising a second wireless communication device comprising:

a receiver for receiving the TDM/CDM signal;

a first despreader for despreading the received TDM/CDM signal with the first covering sequence to produce a despread CDM signal;

a demultiplexer for selecting one of the TDM signals from the despread CDM signal; and

a second despreader for despreding the selected TDM signal with one of the second covering sequences to produce a recovered symbol sequence.

25. A method of multiplexing plurality of symbol streams, comprising:
covering each of a plurality of symbol streams with one of a plurality of covering sequences to form a plurality of covered sequences;
summing the plurality of covered sequences to form a first CDM signal;
and

covering the first CDM signal with a covering sequence to form a first covered CDM signal.

26. The method of claim 25, further comprising multiplying the plurality of covered sequences by a plurality of gain values, respectively, prior to summing.

27. The method of claim 25, further comprising:
combining the first covered CDM signal and one or more additional covered signals; and
transmitting the combined signals to one or more remote stations.

28. The method of claim 25, further comprising:
covering each of a second plurality of symbol streams with one of the plurality of covering sequences to form a second plurality of covered sequences;
summing the second plurality of covered sequences to form a second CDM signal;
covering the second CDM signal with a covering sequence to form a second covered CDM signal;
transmitting the first covered CDM signal on an in-phase channel; and
transmitting the second covered CDM signal on a quadrature channel.

29. The method of claim 25, wherein one or more of the plurality of symbol streams comprises command values, the command values indicating acknowledgment, negative acknowledgment, or acknowledge and continue.

30. The method of claim 25, wherein the covering of each of the plurality of symbol streams comprises:

- segmenting the encoding time into two or more segments;

- covering each of the plurality of symbol streams with two or more sequences, each sequence for covering during the two or more segments, respectively, and the sequence covering each symbol stream during a segment being unique to the respective symbol stream.

31. The method of claim 30, wherein the two or more sequences are Hadamard sequences.

32. The method of claim 30, wherein the two or more sequences are assigned in a time varying manner.

33. A method of multiplexing plurality of symbol streams, comprising:

- covering each of a plurality of symbol streams with one of a plurality of covering sequences to form a plurality of covered sequences;

- summing subsets of the plurality of covered sequences to form a plurality of CDM signals;

- time division multiplexing the plurality of CDM signals to form a TDM signal; and

- covering the first TDM signal with a covering sequence to form a covered TDM/CDM signal.

34. The method of claim 33, further comprising:

- combining the first covered TDM/CDM signal and one or more additional covered signals; and

- transmitting the combined signals to one or more remote stations.

35. A method of decoding a symbol sequence, comprising:
receiving a CDM signal;
despreading the received CDM signal with a first covering sequence; and
despreading the despread received CDM signal with a second covering sequence to produce a decoded symbol sequence.
36. A method of decoding a symbol sequence, comprising:
receiving a CDM signal;
despreading the received CDM signal with a first covering sequence;
time demultiplexing the despread received CDM signal to select a TDM signal; and
despreading the selected TDM signal with a second covering sequence to produce a decoded symbol sequence.
37. An apparatus, comprising:
means for covering each of a plurality of symbol streams with one of a plurality of covering sequences to form a plurality of covered sequences;
means for summing the plurality of covered sequences to form a first CDM signal; and
means for covering the first CDM signal with a covering sequence to form a first covered CDM signal.
38. An apparatus, comprising:
means for covering each of a plurality of symbol streams with one of a plurality of covering sequences to form a plurality of covered sequences;
means for summing subsets of the plurality of covered sequences to form a plurality of CDM signals;
means for time division multiplexing the plurality of CDM signals to form a TDM signal; and
means for covering the first TDM signal with a covering sequence to form a covered TDM/CDM signal.

39. An apparatus, comprising:
means for receiving a CDM signal;
means for despreading the received CDM signal with a first covering sequence; and
means for despreading the despread received CDM signal with a second covering sequence to produce a decoded symbol sequence.
40. An apparatus, comprising:
means for receiving a CDM signal;
means for despreading the received CDM signal with a first covering sequence;
means for time demultiplexing the despread received CDM signal to select a TDM signal; and
means for despreading the selected TDM signal with a second covering sequence to produce a decoded symbol sequence.
41. Processor readable media, operable to perform the following steps:
covering each of a plurality of symbol streams with one of a plurality of covering sequences to form a plurality of covered sequences;
summing the plurality of covered sequences to form a first CDM signal;
and
covering the first CDM signal with a covering sequence to form a first covered CDM signal.
42. Processor readable media, operable to perform the following steps:
covering each of a plurality of symbol streams with one of a plurality of covering sequences to form a plurality of covered sequences;
summing subsets of the plurality of covered sequences to form a plurality of CDM signals;
time division multiplexing the plurality of CDM signals to form a TDM signal; and
covering the first TDM signal with a covering sequence to form a covered TDM/CDM signal.

43. Processor readable media, operable to perform the following steps:
 - receiving a CDM signal;
 - despreading the received CDM signal with a first covering sequence; and
 - despreading the despread received CDM signal with a second covering sequence to produce a decoded symbol sequence.

44. Processor readable media, operable to perform the following steps:
 - receiving a CDM signal;
 - despreading the received CDM signal with a first covering sequence;
 - time demultiplexing the despread received CDM signal to select a TDM signal; and
 - despreading the selected TDM signal with a second covering sequence to produce a decoded symbol sequence.